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Engineering News, Spring 2014

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engineering news
School of Engineering
SPRING 14
SANTA CLARA UNIVERSITY

DEAN'S MESSAGE

Ahhhh spring, when a young man's—or woman's—fancy turns to thoughts of… Senior Design. Well, at least that rings true for the engineering students at Santa Clara University.

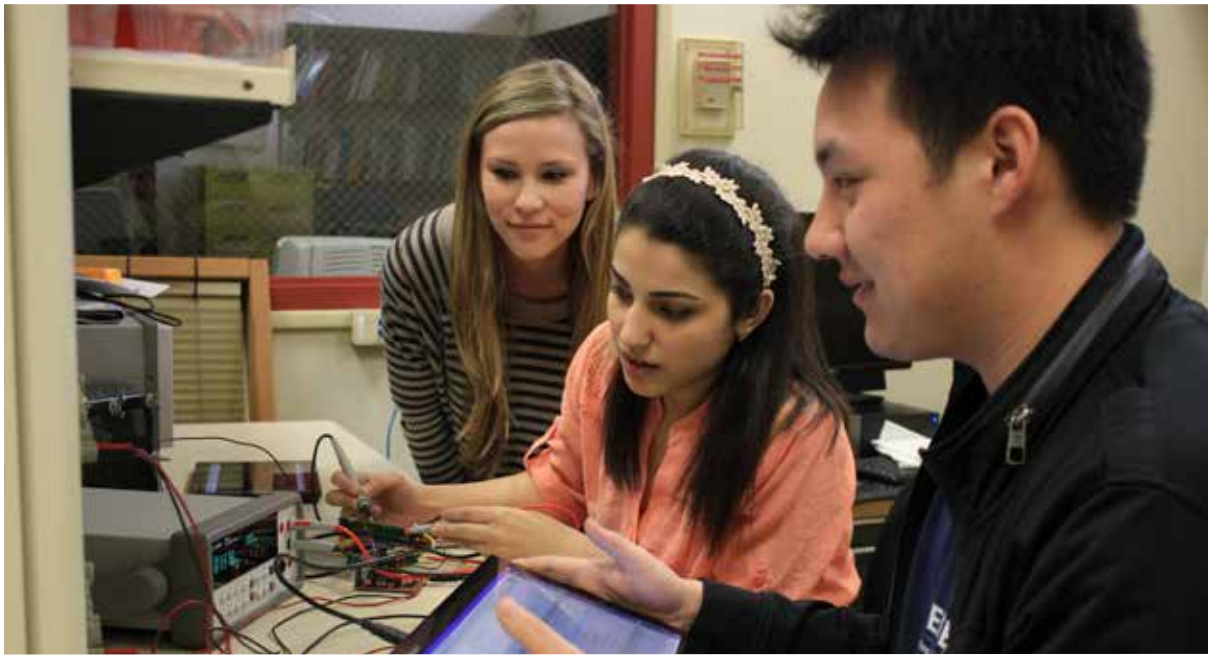
To earn a bachelor's degree in one of the engineering disciplines at SCU, seniors must team up with peers to work on a year-long project, which is presented before a distinguished audience of alumni, industry leaders, faculty, and friends each May. This year, students have been working on projects as varied as designing a prosthetic colon to building an autonomous vehicle. (See all project abstracts here: scu.edu/engineering/srdesign.)

The mix of practical experience, theoretical learning, innovative thinking, teamwork, and presentation skills garnered through working on their senior projects mirrors the competencies graduates will call upon as they begin their engineering careers.

On Thursday, May 8, the School of Engineering will hold its 44th Annual Senior Design Conference. Student presentations will illustrate the distinctive character of SCU engineering—a program that honors our Jesuit, Catholic tradition while taking inspiration from Silicon Valley's innovative, entrepreneurial ethos; a program that pays great dividends in student learning and in contribution to society, as you will learn from reading the articles found in this edition of *Engineering News*. Enjoy!

Godfrey Mungal
Dean
School of Engineering

Photo: J.P Allport



Frances Quinn Hare, Beeta Modarressi, Martin Chuang

Mission to Mars

Electrical engineering seniors Martin Chuang, Frances Quinn Hare, and Beeta Modarressi are working with NASA/Ames Research Center to design a portable, battery-operated, and wirelessly controlled potentiostat to be used in conjunction with a biological fuel cell that may, one day, be sent to Mars. A potentiostat is an electrical circuit used to perform measurements in electrochemistry. NASA utilizes the potentiostat to monitor how well a battery can maintain a certain amount of voltage for a particular amount of time. The project grew out of Modarressi's internship at NASA/Ames Research Center, where she works as part of the Bio-electrochemical Systems Team under the direction of mentor, John A. Hogan, Ph.D. "I knew they needed a less expensive and lightweight version of the potentiostat that is currently used in the lab, so I suggested our team take this on with the help of funding from Dr. Hogan," she said.

Two of the biggest challenges for the team are not only minimizing signal noise for more accurate measurements, but also delivering a user-friendly device so that anyone is able to use it. Modarressi has been focusing on the hardware design of the device while Hare addresses functionality and Chuang, who is double-majoring in electrical and computer science and engineering, does the programming.

For now, the team has a working prototype using a one-on-one connection between a single potentiostat and a receiver. They hope future teams will take up their work, adding to the hardware and proper casing of the device so that multiple units can be used together on a mission to Mars.

Taking it to the Streets

SCU's Mobile Lab, housed within the School of Engineering's Frugal Innovation Lab, partners with community agencies to connect the homeless with food, shelter, and healthcare services.

The age-old problems for homeless young women of finding food, shelter and healthcare services, are being addressed in a whole new way by Oakland, California, nonprofit YTH (Youth + Tech + Health) through their commitment to "pursuing emerging, startling, and sometimes simple technologies that can reach young people where they are." Where they are is on the streets…with their cell phones, relying on the Internet and mobile social networking for critical information and support. Knowing that SCU's Mobile Lab, housed within the School of Engineering's Frugal Innovation Lab, had successfully partnered with another community agency to connect the homeless with available services through text messaging, YTH turned to SCU for help.

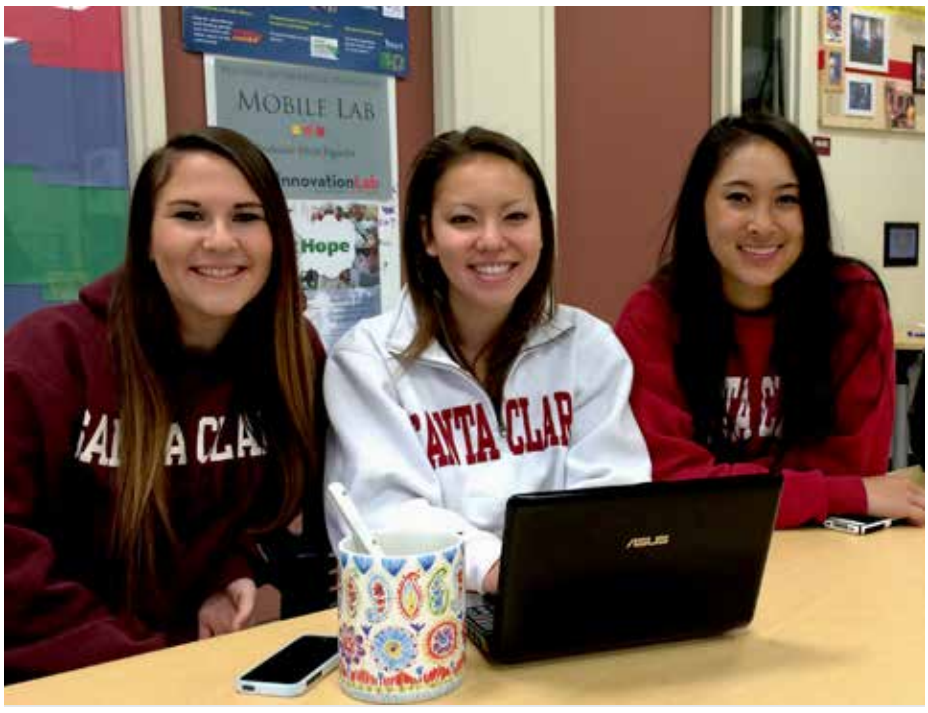
Now, three computer engineering seniors, Kelsey Dedoshka, Kaitlin Kirasich, and Katie Le, have developed Youth StreetConnect, two proof-of-concept mobile apps that the nonprofit is using as the basis for an NIH grant request. The first app, created for healthcare providers to download to a tablet, includes a comprehensive sexual health questionnaire. "Youth are more likely to answer personal questions honestly this way, and we made the interface very simple—just a username and phone number, no password or confirmation. This makes it less intimidating for young people: one field, a phone number, 10 digits, and off you go," said Kirasich. By completing the questionnaire, the user is automatically entered into a database and is invited to download the second Youth StreetConnect app.

This Yelp-style app helps users locate and rate shelter, food, and healthcare services. "There are a lot of resources out there, but the homeless don't necessarily know how to locate or obtain them. Registered users will receive weekly text messages that inform them about services, provide important health information, and other useful material," said Dedoshka.

"When I heard about this project, I immediately thought of these three as the perfect group to take the challenge on," said Computer Engineering Associate Professor Silvia Figueira, who heads the Mobile Lab. "Being in the same age group, they find it easier to relate to the project; they can understand the issues and they have the big picture in mind. Enabling the hooking of this highly at-risk group into the system via healthcare providers in order to disseminate important information about local resources is an important contribution."

"We were interested in doing something that had social benefit," said Le. "Working on a project for a client is more motivational and rewarding than spending time on something more theoretical. Knowing you're doing something for someone else, to benefit someone else's interest and not just your own need, is very fulfilling."

Photo: Heidi Williams



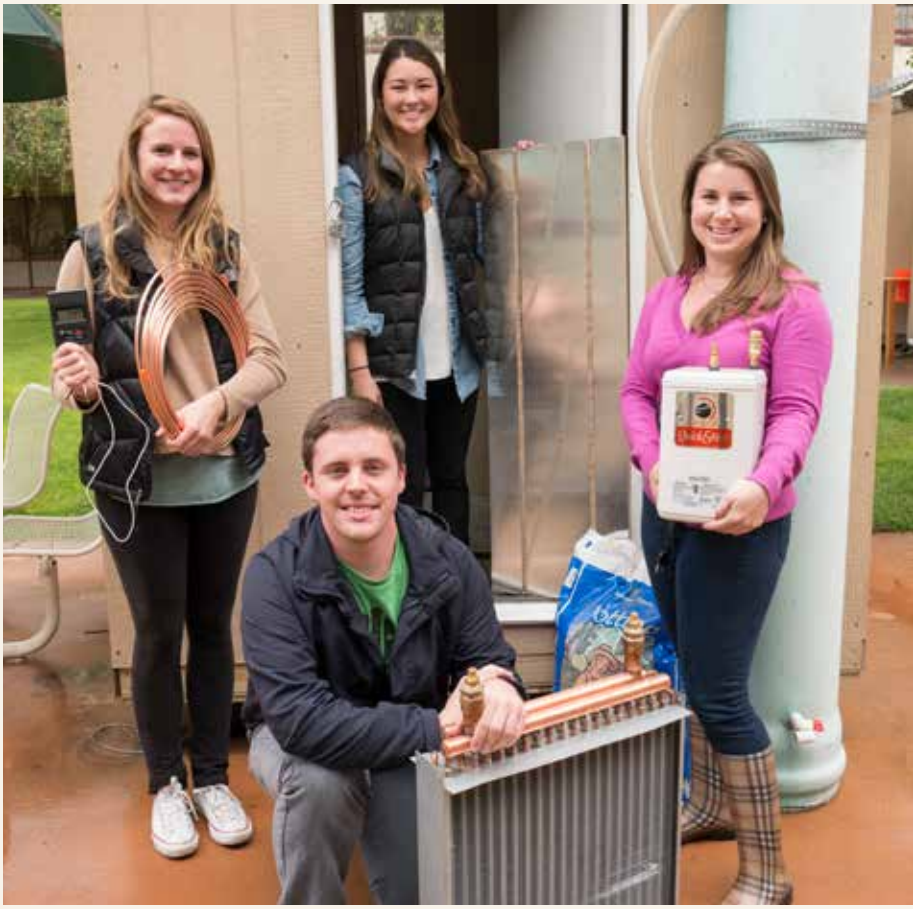
Kelsey Dedoshka, Kaitlin Kirasich, and Katie Le work on their mobile apps in the Frugal Innovation Lab.

yth youth+ tech+health

HAPPINESS IS A WARM GREENHOUSE

A team of civil engineering seniors tests options for a solar greenhouse designed for Alaska's Denali Education Center.

Photo: Charles Barry



From left: Cora Lemar, Sam Heath, Mariko Tollan, and Ashley Husbands get ready to start experiments in their simulated greenhouse.

DENALI EDUCATION CENTER

A Hero Projects "voluntourism" trip to Alaska last summer planted the seed for one civil engineering senior design team's year-long project—to design a solar thermal greenhouse for the Denali Education Center (a nonprofit educational partner of Denali National Park and Preserve), to not only provide fresh produce, but also serve as a model of energy efficiency and best practices.

"When we visited the Center," said Sam Heath of his trip with teammates Ashley Husbands and Cora Lemar, "we learned they have the largest solar thermal array in Alaska, but it is currently only being used for heating water. With 21 hours of sunlight during the summer months, excess heat produced from the array can cause the solar panels to burst, so they were looking for a way to put that extra heat to use."

"The staff at the Center wants to be as sustainable as possible; they want to eat healthy meals, and they already do some gardening in raised beds, but with such a short growing season, they are limited in what they can do," said Husbands. "This project could allow them to expand their growing season and increase the types of food they can grow."

"There is a lot of potential in Alaska for photovoltaic and heating liquid using solar thermal," said Lemar. "Heating (and the dependency on coal and oil) is one of the largest expenses for Alaskans. When you also factor in the cost of shipping produce to outlying areas, you can see how the project can help save them money while shrinking their carbon footprint."

Back at Santa Clara, the three quickly recruited Mariko Tollan to join the team and set to work on the four elements of their project: structural design of the greenhouse, foundation design, mechanical heating system, and a storm water collection system to be used for irrigation. "One of the biggest challenges in designing the mechanical system is figuring out what will work best," said Tollan. "Do we heat with a radiator or through the floor? How much sunlight will be coming in? How do we keep the greenhouse at a constant temperature? We're testing different options in a simulated environment here on campus."

Information on snow and wind loads, and geotechnical advice has come from engineers contacted through local chapters of professional societies. The team has also been in touch with vendors and glazing manufacturers to learn how much load and deflection their monoslope roof design can take, and they have regular conference calls with the folks at the Denali Educational Center. "Their excitement about what we're doing makes us even more engaged," said Heath.

GETTING AN UNMANNED ROVER UNDER CONTROL

Red Rover, Red Rover, send an autonomous vehicle right over! That's exactly what mechanical engineering seniors Garrett Bonner, Owen Hale, Julian Pitt, and Andrew Torrellas are striving to do. For the past year, these four have spent countless hours in a tiny workshop building an unmanned test vehicle to be used by the School of Engineering's Robotics Systems Laboratory (RSL).

Getting the Rover to this stage has been quite a feat. The team inherited the vehicle from the University of California at Santa Cruz, who had received it from a privateer team who had entered it in a DARPA challenge. But rather than trying to figure out where the previous groups had gone wrong, SCU's team stripped it down and started rebuilding from the ground up. "We've got the vehicle of computer and electrical engineering to implement our ideas and control the mechanical systems has been challenging," said Hale, "but it's really been a team effort. We get on each other when we need to, but we're such a small team, we work on everything together and don't have formal positions." Tasks are listed on a white board in the workshop; whoever wants to work on a particular item writes his name next to it, and the job gets done.

Next steps include testing at the RSL's research lab located at nearby NASA/Ames Research Center, and then passing the vehicle off to the next team of students who will add more functionality. "This vehicle will become a new research testbed for exploring automation technologies for cars and other vehicles," said the team's advisor Associate Professor and RSL Director Chris Kitts, who added, "This is certainly an exciting technology that will play an increasing role in our day-to-day lives."

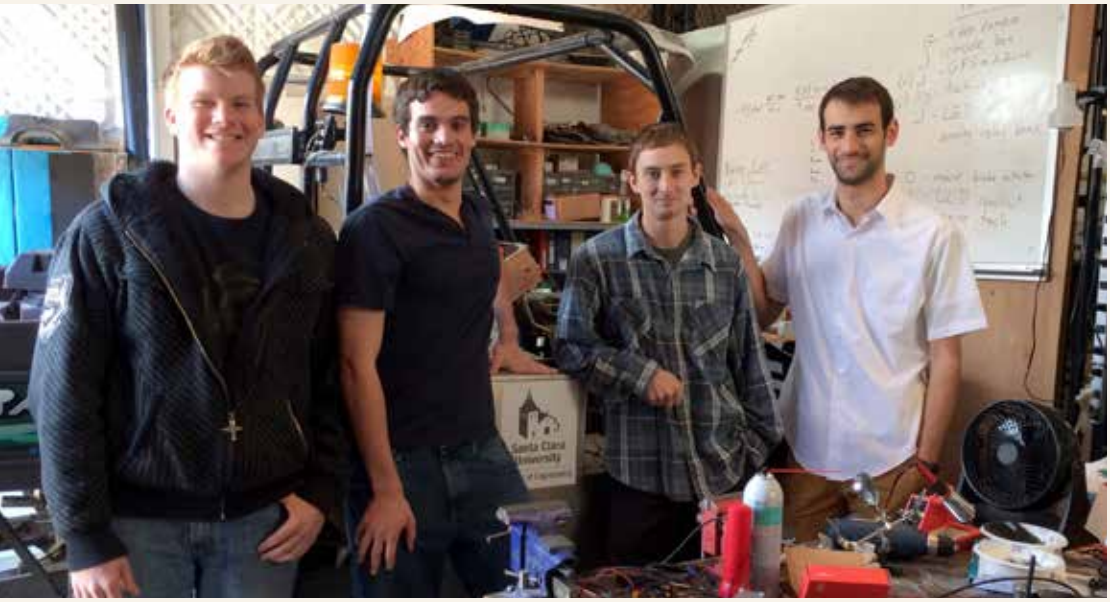


Photo: Heidi Williams

From left: Mechanical engineering seniors Garrett Bonner, Andrew Torrellas, Owen Hale, and Julian Pitt with their ROV

"Right now, it is fully functional by remote control, but hopefully someday it will be autonomous like the Google car," said Torrellas. Bonner added, "We've programmed the radio module to send serial commands to the onboard XBee and range tested it the other day; it was still sending data from half a mile out. Eventually, we should get to nine miles without interference."

control system working as a prototype; the first iteration of speed control is working; the architecture works, but it needs to be tuned for real-world use and packaged for rain protection, etcetera," said Pitt.

Self-described lifelong car nuts, the team is getting lots of hands-on experience in engineering disciplines outside of their major and in project management. "Using the other fields

Going the Extra Mile

Great strides have been made in delivering vaccines to urban centers in developing nations around the world, but for many, access to these life-saving drugs is inhibited by an inability to safely transport the medicine from regional health centers to remote, rural communities. That's where mechanical engineering seniors Paul Novisoff, Arturo Nunez Perez, and Ryne Sitar come in.

Under the direction of their advisor, Assistant Professor Hohyun Lee, the team is developing a lightweight, solar-powered, thermoelectrically cooled unit that can fit inside a backpack to be worn by couriers for the safe transport of medicine by foot or bicycle. The active cooling system will allow the container to be opened and closed while still maintaining a specified temperature range for the payload.

"The way we've designed the system is unique, compared to other products on the market," said Novisoff. "Using a heat pipe and exhaust fans to efficiently extract heat from the peltier module allows a high coefficient of performance for cooling the conditioned space. An example of a passive system would be a Styrofoam-insulated box with ice or cold packs; our active system is powered by batteries recharged by small solar panels," Novisoff explained. "It's an energy-efficient way of transporting vaccines for last mile distribution," said Nunez Perez, who notes that their product is not meant to be used as a "standby device," meaning it is designed for transport, not long-term storage.

Having built a prototype from birch wood, the team is working on finding the optimum operating current to consistently deliver the right temperature to an insulated chamber housing the 1.2 liter capacity unit, which will hold approximately two dozen vaccine vials. "The finished product will be made from plastic with an interior aluminum fitting to provide effective conductivity and heat sinks to improve the convection and cool the air within the entire interior space," said Sitar.

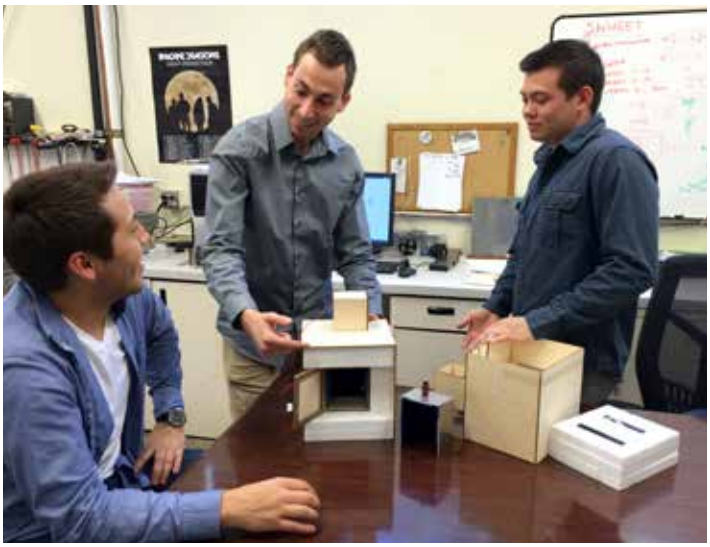


Photo: Heidi Williams

Ryne Sitar, Paul Novisoff, and Arturo Nunez Perez with the prototype of their mobile cooler

"This is a multi-year project and will be multi-disciplinary moving forward, but we got it off the ground and the next team to take it up will be off to a good start."

Photo: Paul Novisoff

A closer look at the inside of the solar-powered, thermoelectrically cooled unit

> ***"The way we've designed the system is unique, compared to other products on the market. Using a heat pipe and exhaust fans to efficiently extract heat from the peltier module allows a high coefficient of performance for cooling."***
>
> ***— Paul Novisoff '14***

Designing a Better Quality of Life

Improving patients' lives is a big motivation for the student team designing an internal colostomy bag. With a very promising prototype designed, they will soon be ready to test their device on a porcine model.

Department of Bioengineering term lecturer and advisory board member Gerardo Noriega, engineer, inventor, and entrepreneur with more than 25 years in the medical device industry, is passionate about finding solutions to problems that hit close to home. So when a family member's surgical complication led to a colostomy, he shared the experience with the bioengineering students who were looking for a challenge they could take on for their senior design project.

Seniors Marissa Crosetti, Jeffrey Dunbar, and Lia Vosti immediately recognized the problems associated with an external vessel for the collection of waste and wanted a better option for patients, so they set about designing an internal colostomy bag to improve users' lives. They recognized that, while leakage, infection, and irritation are bad enough, addressing the embarrassment and decline in quality of life is equally important to a patient's well-being. Collaborating with Olakunle O. Ajayi, M.D., a colorectal surgeon with Kaiser Permanente in Oakland, California, the trio is developing an implantable device made from biocompatible material that will appeal to both surgeons and patients. Their ideas are sound enough that Dr. Ajayi has advised they will soon be ready to test their device on a porcine model to see how the intestine will respond, and a provisional patent has been submitted for the device they have termed, "Recepticol."

"Our idea is for an internal bag that can drain with a catheter or other option," said Crosetti. "With no stoma, or hole left open, the body will be able to heal around the port so the intestine—which is meant to be internal—is not exposed to the world." According to Vosti, "Our two main engineering components are the connection to the small intestine on the inside, and the connection to the external port for drainage."

The students are also being advised by adjunct lecturer Shane Rogers, engineer, entrepreneur, and alumnus of SCU's Engineering Management and Leadership program. The team took a product assessment class with Rogers, which helped immensely as they began to identify clinical need for their target group of patients who have had all or part of their large or small intestine removed.

As the Senior Design Conference approached, the team focused on producing a prototype. "At this point we have to take an educated guess based on the 12 months of research we've done, the feedback we've received from the surgeon and a mechanical engineer we've been working with, and the expertise of our advisors," said Dunbar.

"We're excited," said Crosetti, "it's been a huge whirlwind of unknowns, and initially just started as a senior design project, but it's really grown. This is like real life; that's what we keep getting told!"

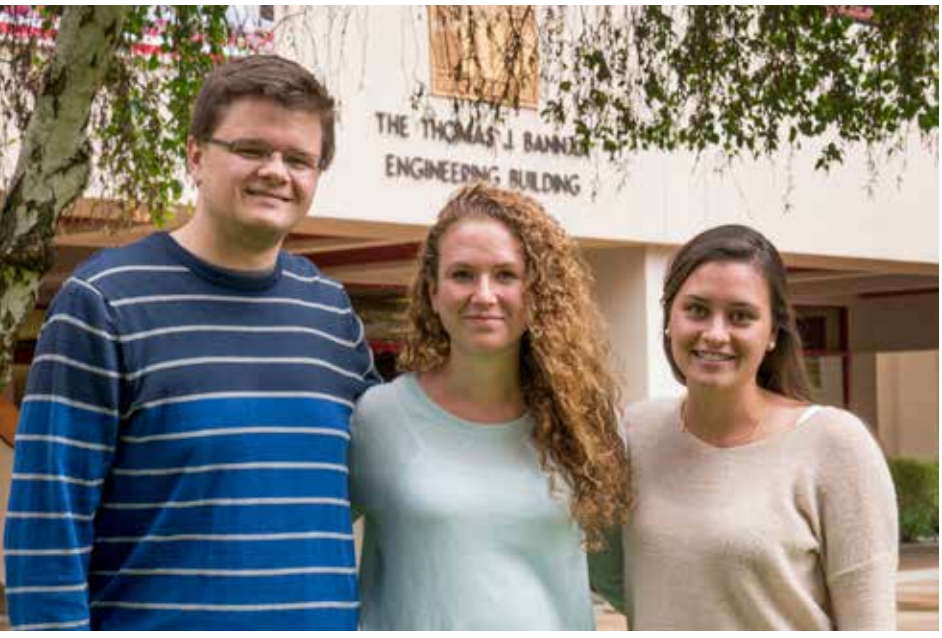


Photo: Charles Barry

Jeffrey Dunbar, Lia Vosti, and Marissa Crosetti

GOTTA DANCE...AND DESIGN... AND EXPLORE...

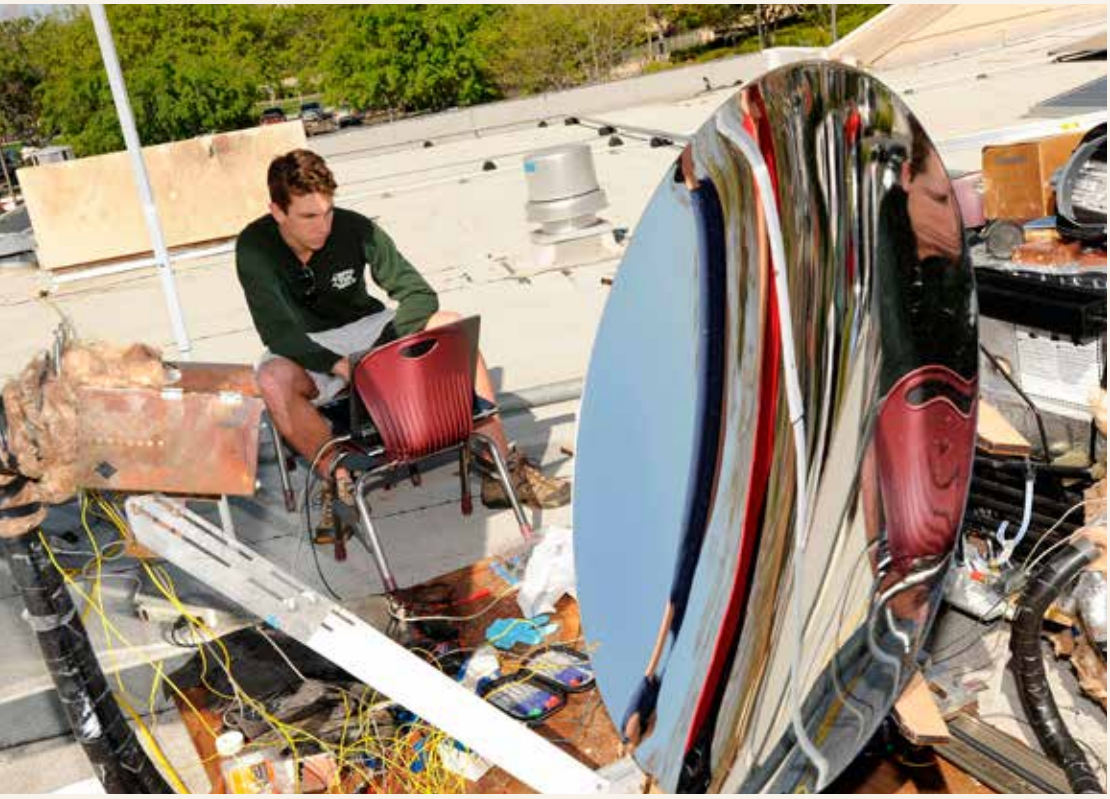


Photo: Charles Barry

On the roof working on a solar-powered absorption chiller or in the dance studio perfecting his technique, Coulter exemplifies Santa Clara's goal of educating the whole person.

Though Mark Coulter '14 transferred into Santa Clara Engineering from a community college in Monterey, California, he has made the most of his time here and is a great example of how Santa Clara strives to "educate the whole person."

Two years before coming to SCU, Mark fell for a girl who got him interested in ballroom dancing. The relationship didn't work out, but the love for dance grew. When he enrolled at Santa Clara, it was as a mechanical engineering major and a dance minor. "I love the T-model that Santa Clara uses, and I see how it has helped to shape me to be both analytical and communicative, technical and creative," he said. The T-model Mark refers to is SCU's approach to engineering education that pairs a deep technical core (math, science, engineering, design) with a broad set of soft skills essential for success (communication, ethics, integrity, creativity, global view). "Because of dance, I'm more open, and I like being that kind of person. Still, it's a process, and Santa Clara preaches this to students: you're created by an entire lifetime and by your experiences, you're not just one thing—an engineer or a dancer. It's important to realize that to start growing."

This quarter is a busy one for Mark as he finishes up his senior design project, working with teammates on a solar-powered absorption chiller for use in underdeveloped nations, while also rehearsing four dances to perform with fellow dancers in a classmate's senior spring recital. In his spare time, he's been very involved in getting a new club on campus, "Into the Wild," off the ground. As vice president, he has helped grow the club from 3 leaders to 20 and transition into a Chartered Student Organization. "I feel good about getting students off campus for Sunday hikes, weekend trips of biking, river rafting, or camping, and spring break trips to the Channel Islands, Grand Canyon, or Zion National Park—safe fun that isn't alcohol related. It's so important to have a variety of experience."

With all of his interests, it's good to know that engineering is Mark's first priority. "Working on senior design has been my favorite experience at SCU and I'm starting to apply and interview for engineering jobs. You can't deny the contacts and networking opportunities SCU provides. Dance is extracurricular and I love it, but I'm excited to start my career in engineering."

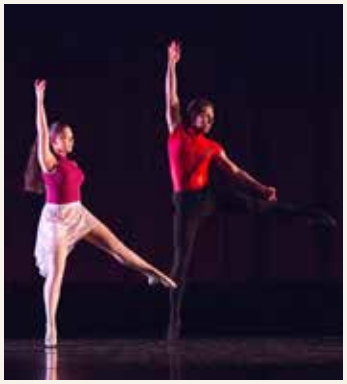


Photo: Marluve Veltze–SCU Presents Department of Theatre and Dance

Coulter and classmate perform in SCU's Choreographers' Gallery.

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ALUM FINDS SECOND LIFE FOR ENGINEERING

Warren Savage '93

A deep-seated desire to maximize the value of engineers' work and a focus on partnership are two of the driving forces that have brought computer engineering alumnus Warren Savage '93 to his position as leader in the field of semiconductor intellectual property (IP) management. As founder and CEO of IPextreme, a company based in Campbell, California, with offices in Munich and Tokyo, he is passionate about liberating captive IP and enabling collaboration.

Savage began his career in the semiconductor industry more than 30 years ago, and was eventually recruited by Synopsys to manage their R&D teams in America, Asia, and Europe. It was there that he realized the major semiconductor companies he was working with were sitting on large amounts of captive IP that had the possibility of being commercially licensed. In 2004, he and a group of Synopsys veterans banded together to start IPextreme.

"It was a very radical idea at the time," Savage said. "The first challenge was convincing semiconductor companies that not all of their assets needed to be held secret; they could be exploited. With the economic downturn in 2003, companies began to see the opportunity of turning design team cost centers into profit centers. Finding a second life for technologies that had already been developed could add to the revenue stream and generate more technology. The only way to keep on a growth curve was to build on work that had already been done. IPextreme was founded to enable this; we act as an intellectual firewall between companies that want to share technology."

Fast forward to 2014 and the company is celebrating its 10th anniversary. Through their innovative IP management software, Xena™, they are able to license and distribute IP and support those products all over the world. "We found a good way to monetize and put a value on engineers' work outside its original purpose, which creates a long tail on the technology's life. IP can have a useful life of 30 to 50 years when it is appropriately packaged and managed. When engineers' work really reaches its full potential, it doesn't die before its time," said Savage, whose next mission is to take the democratization of IP to the next level. "We are changing the way the semiconductor industry works." Part of that change involves bringing smaller tech-focused IP companies together through the Constellations™ cooperative—teaching them how to be successful in the IP business, doing marketing shows together, and dividing costs so all can participate. "It's our way of giving back."

Learn more about award-winning IPextreme: **www.ip-extreme.com**

IPextreme

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